# Syllabus for M.Tech. Communication Engineering

| 1ST SEMETER | | | | | | |
|---|---|---|---|---|---|---|
| **THEORITICAL SUBJECTS** | | CREDIT | PERIODS/WEEKS | | MARKS | |
| | | | L | P | EXAM | SECS |
| PG/ETC T-101 | NOISE & INFORMATION THEORY | 04 | 3 | | 100 | |
| PG/ETC T-102 | DIGITAL DATA COMMUNICATION | 04 | 3 | | 100 | |
| PG/ETC T-103 | COMPUTER COMMUNICATION NETWORK & CODING THEORY | 04 | 3 | | 100 | |
| PG/ETC T-104 | ADVANCE MICROWAVE THEORY | 04 | 3 | | 100 | |
| **SESSIONAL SUBJECTS** | | | | | | |
| PG/ETC L-101 | LABORATORY-I | 03 | | 4 | | 100 |
| PG/ETC L-102 | ASSIGNMENT-I | 03 | | 4 | | 100 |
| PG/ETC L-103 | SEMINAR-I | 03 | | 4 | | 100 |
| | TOTAL | 25 | 12 | 12 | 400 | 300 |

TOTAL PERIODS/WEEKS: 24
TOTAL MARKS : 700

| 2ND SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| **THEORITICAL SUBJECTS** | | CREDIT | PERIODS/WEEKS | | MARKS | |
| | | | L | P | EXAM | SECS |
| PG/ETC T-201 | SATELLITE COMMUNICATION | 04 | 3 | | 100 | |
| PG/ETC T-202 | ADVANCED ANTENNA THEORY & MICROWAVE FILTER | 04 | 3 | | 100 | |
| PG/ETC T-203 | OPTICAL COMMUNICATION SYSTEM | 04 | 3 | | 100 | |
| PG/ETC T-204 | WIRELESS & MOBILE COMMUNICATION SYSTEM | 04 | 3 | | 100 | |
| **SESSIONAL SUBJECTS** | | | | | | |
| PG/ETC L-201 | LABORATORY-II | 03 | | 4 | | 100 |
| PG/ETC L-202 | ASSIGNMENT-II | 03 | | 4 | | 100 |
| PG/ETC L-203 | SEMINAR-II | 03 | | 4 | | 100 |
| | TOTAL | 25 | 12 | 12 | 400 | 300 |

TOTAL PERIODS/WEEKS: 24
TOTAL MARKS : 700

| 3RD SEMESTER | | | | |
|---|---|---|---|---|
| **THEORITICAL SUBJECTS** | | CREDIT | PERIODS/WEEKS | MARKS |
| PG/ETC T-301 | DESIGN WORK | 12 | FULL TIME | 200 |
| PG/ETC T-302 | TERM PAPER LEADING TO THESIS | 12 | FULL TIME | 100 |
| TOTAL | | 24 | | 300 |
| **4TH SEMESTER** | | | | |
| **THEORITICAL SUBJECTS** | | CREDIT | PERIODS/WEEKS | MARKS |
| PG/ETC T-401 | PROJECT WORK | 20 | FULL TIME | 200 |
| PG/ETC T-402 | VIVA-VOCE ON THESIS | 04 | FULL TIME | 100 |
| TOTAL | | 24 | | 300 |

## PG/ETC-T101 NOISE AND INFORMATION THEORY

Band limited white noise; Wiener Kinchin theorem and its application to narrow band noise; Frequency domain representation of noise: Effect of filtering :Superposition and mixing involving noise; Noise bandwidth; Quadrature component of noise.

Basic concept of Information Theory: A quantitative measure of information and its unit.

Information Theory for discrete memoryless schemes: Measure and justification ,Formal requirements and properties, Sources and Binary sources, Joint and Conditional entropies. Relationship between different entropies. Measure of mutual information, Channel Capacities, Redundancy and efficiency, Capacities of various discrete channel.

Elements of minimum redundancy coding: Uniquely decodable codes, Instantaneous code and compact code, Av. Length of codes, Shannon Fano encoding, Huffman Encoding, Redundancy and efficiency, Capacities of various discrete channel.

Information Theory for memoryless continuous cases:

Definition of different entropies, mathematical difficulties involved, Infiniteness and variability of continuous entropy. Measure of Information, Maximisation of entropy, Channel capacity for Gaussian noisy channel.

Information Theory for schemes with memories:

A) Stochastic processes: Examples, Moments and Expectations, Stationary and Ergodic Processes, Correlation coefficients and functions, Power spectrum Stochastic limits and convergence, stochastic differentiation and integration, finite Markov chains.
B) Entropy of simple Markov chains, Entropy of discrete stationary sources.

Fundamental Theorem of Information Theory:

Decision scheme and associated probability of error, Relation between error probability and equivocation, Einstein's proof fundamental theorem. Shannon's proof of fundamental theorem.

## PG/ETC-T102DIGITAL DATA COMMUNICATION

Data terminals and interface, Data Transmission over: telephone lines, RF lines and Satellites. Synchronous Start Stop and Asynchronous Multiplexing methods, Signal shaping-optimum transmitter and receiver filters , Eye pattern, Correlative signal coding :Duo-binary and Pseudo ternary coding. Detection process for sampled baseband signals, Linear Equalisation, Decision directed Equalisation, Detection of Orthogonal group of signal elements, optimum detection and intersymbol interference cancellation. Practical systems like superheterodyne, stereo, rake, etc.

## PG/ETC-T103 COMPUTER COMMUNICATION NETWORK AND CODING THEORY

Introduction of transport of data traffic over networks of digital transmission media, architecture concepts in ISO's OSI layered model in computer communication. Physical layer standards, Data link layer, ARQ scheme and their analysis. Delay models based on queuing theory. Network layer, Topology, routing,

flow control, congestion control, inter networking, Multiple access, local area network (LAN) IEEE standards for LAN's Transport layer, issues and standards integrated service network.
Communication protocol: Higher protocol layer, transport layer, session layer, design issue and RPC's presentation layer, Design Issue, Cryptography, virtual protocols.
Introduction to Algebra: Groups, modulo-m addition, modulo-m multiplication, fields, Galois fields and their properties, vector spaces and their properties.
Linear Block Codes: Generator matrix, parity check matrix, encoder implementation syndrome, decoding, Hamming codes, standard array, product codes.
Cyclic Codes Description, systematic structures, generator and parity check matrices, encoding, syndrome, decoding, Cyclic Hamming code, shortened cyclic codes, correction of double errors.

## PG/ETC-T104 ADVANCED MICROWAVE THEORY

**Mathematical model of Microwave Transmission:** Concept of Model . Characteristics of TEM, TE and TM Modes. Losses associated with microwave transmission. Concept of Impedance in Microwave transmission.
**Analysis of RF and Microwave Transmission Lines:** Coaxial Line. Rectangular Waveguide. Microstrip Line.
**Microwave Network Analysis:** Equivalent Voltages and currents Model Network parameters for microwave Circuits. Scattering Parameters.
**Passive and Active microwave Devices:** Microwave Passive components: Directional Coupler, Power Divider. Microwave Passive components: Magic Tee, attenuator, resonator. Microwave Filter Design Microwave Active components: Diodes, Transistors. Microwave Active components: oscillators, mixers. Microwave tubes: Klystron, Magnetron.
**Microwave Antenna:** Microwave Antenna Parameters. Antenna for ground systems. Antenna for airborne based systems. Antenna for satellite Microstrip antenna
**Microwave Measurements:** Power, Frequency and impedance measurement at microwave frequency. Network Analyser and measurement of scattering parameters. Spectrum Analyser and measurement of spectrum of a microwave signal. Measurement of Microwave antenna parameters.
**Microwave Systems:** Radar , GPS.
**Modern Trends in Microwaves Engineering:** Effect of Microwaves on human body. Medical and Civil applications of microwaves. Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC).

## PG/ETC-T201 SATELLITE COMMUNICATION

Historical development of satellites: Communication satellites; orbits and description, orbital period and velocity, azimuth and orbital inclination, coverage angle and slant range, eclipse, placement of satellite in geostationary orbit.

Satellite Description: Communication subsystem, Telemetry, command and ranging subsystem, altitude control subsystem, electrical power subsystem.
Earth station: earth station antenna type, gain, pointing loss. Antenna gain to noise temperature variation G/T. G/T measurements. Antenna tracking power amplifier, low noise amplifier, Up-converter , Down-converters–conversion process; transponder hopping, polarization hopping, redundancy configuration. Spurious effect of frequency conversion.
Satellite transponder: Transponder model, transponder channelization, frequency plans and processing transponders.
Satellite link: Basic link analysis, interference analysis, Rain induced attenuation, satellite link design, link with frequency reuse and link without frequency reuse, satellite multiple access system.
Frequency Division Multiple Access: Principle, SPADE, FDM-FM-FDMA, Companded FDM-FM-FDMA and SSB-AM-FDMA, Intermodulation products in FDMA, optimized carrier-to-intermodulation plus noise ration.
Time Division Multiple Access: Principle, TDMA frame structure, TDMA burst structure, TDMA superframe structure, frame acquisition and synchronization. Satellite position determination, TDMA timing . Demand Assignment Multiple Access and digital speech interpolation. Earlang B formula.Type of demand assignment , DAMA characteristics, real time frame reconfiguration, DAMA interfaces, SCPC- DAMA, digital speech interpolation. Satellite packet communication.
Satellite Spread Spectrum Communication: Direct Sequence Spread Spectrum System, Direct Sequence Code Division Multiple Access. Frequency hop spread spectrum system, frequency hop CDMA DS and FH acquisition and synchronization. Satellite on board processing.
Very Small Aperture Terminal Network(VSAT) – VSAT technologies, network configurations, multi access and networking. Network error control polling VSAT network.
Mobile Satellite Network(MSAT)- Operating environment, MSAT network concept, CDMA MSAT re-link . Worldwide timing by satellite relay.

**PG/ETC-T202 ADVANCED ANTENNA THEORY & MICROWAVE FILTER**

**Fundamental Concepts:** Physical concept of radiation, Radiation pattern, near-and far-field regions, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation.
**Radiation from Wires and Loops:** Infinitesimal dipole, finite-length dipole, linear elements near conductors, small circular loop.

**Aperture and Reflector Antennas:** Radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas.
**Microstrip Antennas:** Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.
**Antenna Arrays:** Analysis of uniformly spaced arrays with uniform excitation amplitudes, extension to planar arrays, synthesis of antenna

## PG/ETC-T203 OPTICAL COMMUNICATION SYSTEM

Optical waveguides, Electromagnetic mode theory for optical wave propagation, Transmission characteristics of optical waveguides, Single mode & multimode waveguides.
Optical fibres types: polymer fibre, silica fibre, polarization maintaining fibre, fluoride fibre rare-earth doped fibres and their characteristics.
Fabrication of optical fibres, fibre parameter measurements.

Passive fibre optic components, fibre optic switches, fibre gratings etc. Fibre amplifiers.
Optical sources for fibre communication, Optical detectors for fibre optic communication, Modulation techniques, Optical transmitters, design considerations of fibre optic digital communication, Design considerations of analog communication system,. Calculation of power budgets.
Fibre optic network topology & principles, LAN, MAN, CSMA, CDMA, FDDI networking. Multiplexing methods in fibre optic networks. Fibre optic CATV network systems. Concepts of WDM. Principles of soliton wave propagation through optical fibres. Principles of coherent communication in optical fibres.

## PG/ETC-T204 WIRELESS AND MOBILE COMMUNICATION SYSTEM

Introduction to wireless communication system: Mobile Telephone system around the world, example of mobile radio system, paging, cordless, cellular telephone system.
Cellular concept-system design fundamentals, radio propagation-large scale path loss, small scale fading and multipath fading,. Properties of antenna system. Cell coverage, cell site and mobile antenna. Frequency management and channel assignment. Hand off and drop cells. Protocol studies and design.
Mobile system design- Base station design, mobile receiver, modulation techniques in mobile radio, multiple accessing techniques, wireless networking, Wireless system and standards-GSM services and features, CDMA services, CSMA etc. Wireless standards 2G, 2.5G, 3G+/4G. Wireless communication trends and services.
Introduction to Global positioning system (GPS), introduction to ad-hoc mobile network.

All laboratories, assignments and seminars are pertaining to theoretical subjects.